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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
F01C 1/344, F02B 55/14, 55/16, 53/00

A1

(11) International Publication Number: **WO 99/04141**

(43) International Publication Date: 28 January 1999 (28.01.99)

(21) International Application Number: PCT/NZ98/00102

(22) International Filing Date: 15 July 1998 (15.07.98)

(30) Priority Data:
314072 16 July 1997 (16.07.97) NZ

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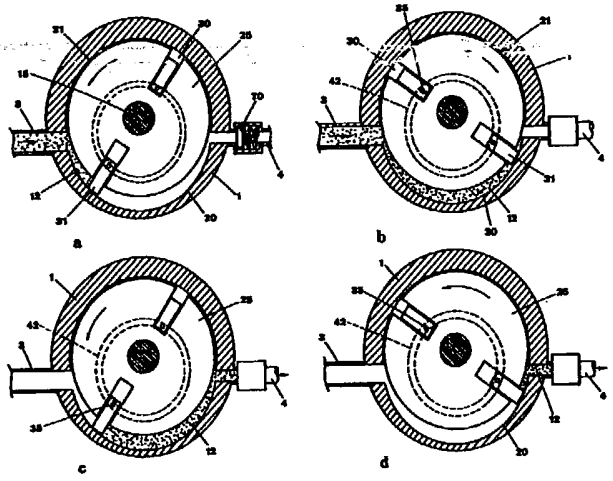
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published**
*With international search report.*
*Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: A VANE TYPE ROTARY ENGINE




(57) Abstract

A vane type rotary engine having separate substantially identical stators (1, 2) joined by a common drive shaft (15). One stator (1) forms the induction/compression stage and the second stator (2) forms the combustion/exhaust stage. A rotor (25) having a circular periphery (26) is housed within the bore of each stator (1, 2) by the common drive shaft (15) and the bore of each stator is in the shape of a first and a second arc (21, 20) with each arc having a separate axis. The rotor (25) is located within the bore on the drive shaft (15) so its peripheral surface (26) is closely spaced to the first of the arcs (21). At least one vane (31) has sliding reciprocal movement in a radial slot (30) formed in the rotor. Each vane (31) has a pin (35) which engages within a groove (42) formed in an end wall (41) of the bore. The groove (42) has an axis that corresponds to the axis of the second of the arcs (20). As the rotor (25) rotates the engagement of the pin (35) in the groove (42) will reciprocate the vane (31) radially within the slot (30) in the rotor (25) to maintain a sealing contact between the tip of the vane and the wall of the bore of the stator (1, 2).

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**Title**

A vane type rotary engine

**Background to the Invention**

A rotary internal combustion engine is recognised as being superior in many aspects to a reciprocating internal combustion engine. Particular advantages are generally considered to be fewer moving parts and consequently less manufacturing costs and better reliability. In addition rotary engines do not generate much vibration which is an inherent problem with reciprocating engines.

A rotary engine generally includes a stator, the interior of which is substantially cylindrical to form a chamber and a rotor, the periphery of which is shaped so that as the rotor rotates within the stator, it will provide the necessary induction, compression, combustion and exhaust phases. A continuing difficulty with rotary engines lies in excessive wear in the sealing between the periphery of the rotor and the wall of the chamber of the stator. Another known problem with rotary engines is that the thermal efficiency of known rotary engines is usually inferior to that of reciprocating engines resulting in undesirably high fuel consumption.

One form of known rotary engine is the "Wankel" engine which utilises a rotor which rotates within a toroidal engine chamber. Such engines suffer from problems such as leakage at the seals of the rotor apexes and leakages at the side seals. This not only causes overheating and lubrication problems, but particularly at high revolutions per minute, the

wear in the seals becomes excessive thereby limiting the life of the engine. In spite of continuous development of the "Wankel" type engine, it has not received universal acceptance because the inherent problems of excessive wear and fuel consumption have not been solved.

Another type of known rotary engine uses a stator having a substantially circular interior chamber with a rotor formed to rotate within the chamber, the rotor being provided with one or more radially sliding vanes, the tips of which seal against the wall of the chamber.

**Prior Art**

One form of rotary engine that utilises sliding vanes is the subject of US Patent Specification 5494014 (Lobb) which describes an engine having a casing with an elliptically shaped bore. The rotor has two recesses which house two diametrically mounted rotor segments which are pivotally mounted to the rotor in such a manner that the segments will be forced outward by centrifugal force. Vanes are mounted in slots formed in the rotor to form a seal between the rotor and the inner surface of the bore. The narrowing of the space between the rotor and the elliptical shaped bore will compress the air/fuel mixture which is ignited by the usual method using a spark plug.

US Patent specification 4414938 (Umeda) also describes a rotary internal combustion engine which utilises a vane. The engine has a stator having a bore with part of the wall of the bore being in cross sectional shape a part of a circle. The remainder of the

wall is of an elliptical shape having a constant diameter through the centre of the circular cross-sectional shape. The rotor is coaxially closely in contact with the circular shaped part of the wall and the vane has a dimension which is equal to the constant diameter.

US Patent specification 4515123 (Taylor) includes a power rotor which rotates within a bore of a stator housing. The rotor has spring-loaded sliding vanes seated in radial slots in a manner that the tips of the vanes will seal against the bore of the stator. A rotary transfer valve has a number of pockets in its surface and is in sealing contact with the interior surface of the cylindrical cavity. A cam wheel is connected to the main rotating shaft and will intermittently rotate the transfer valve to transfer compressed gases from the leading side of the vane to the trailing side of the vane.

US Patent specification 5352295 (Chou) also discloses a rotary engine which utilises a single vane and an eccentric rotor housed within a circular bore of a chamber of a stator. The engine uses two substantially identical sets, one being a compressing portion and the other being a working portion, with the compressing portion and the working portion sharing a common output shaft. The combustible gas is compressed in the compressing portion and is then transferred into the working portion where it is ignited and then exhausted. The vane is secured to the output shaft and extends through the rotor with the tip of the vane sealing against the bore of the chamber.

US Patent specification 5415141 (McCann) discloses a rotary engine in which the bore of the stator is elliptical. The rotor, which is mounted on a shaft which extends

through the axial centre of the bore, has a circular periphery. The rotor includes a number of radial vanes which extend through the rotor in a manner that the tips of the vanes will seal against the bore of the stator. The side-wall of the stator is formed by an elliptical plate which has an elliptical groove similar in shape but smaller than the elliptical bore. A number of radial slots are formed in the rotor to receive vanes which are provided with pins which engage within the elliptical grooves in the side plate. As the rotor rotates, the pins of the vanes will follow the grooves and thereby cause the vanes to reciprocate within the slots to maintain the tips of the vanes in contact with the bore of the stator.

It is apparent from the prior known devices, that it is known to utilise vanes to effect the sealing during rotation of the rotor and that various means have been proposed to maintain the tips of the vanes in contact with the bore of the stator. However in all prior known forms of the engines, the construction of the rotor and the stator is overly complicated and this results in manufacturing difficulties and in the maintenance of the engine.

**Object of the invention**

It is therefore an object of this invention to provide a simplified form of construction of a rotary engine using a sliding radial vane or vanes that will at least go some way towards overcoming the prior known difficulties. It is also an object of this invention to provide an engine that utilises sliding vanes and which is comprised of two sections, an induction/compression section and a combustion/exhaust section.

**Disclosure of the invention**

Accordingly one form of the invention comprises a rotary engine having separate induction/compression and combustion/exhaust units, each unit comprising a substantially identical stator having a bore into which an inlet port and an exhaust port communicate.

each stator housing a rotor which has a circular peripheral surface, the rotor being adapted to have rotatory movement within the bore by being connected to a common drive shaft journalled in bearings supported by the stators,

wherein the surface of the bore of the stator is in the shape of a first and a second arc having separate axes with at least the first arc being part of a circle and wherein the peripheral surface of each rotor is closely spaced from the wall of the bore formed by said first arc,

each rotor being provided with at least one vane which has a radial reciprocating movement guided within a slot formed in the rotor in a manner that as the rotor rotates, the vane will reciprocate in the rotor to maintain a sealing portion of the vane in sealing contact with the surface of the bore of the stator.

Preferably the reciprocating movement of the vane is controlled by control means to maintain the tip of the vane in sealing contact against surface of the second arc of the bore of the stator during rotatory movement of the rotor.

Preferably the control means comprises a continuous groove formed in at least one side wall of the stator with the shape of the groove complementing the shape of the said second arc and wherein the vane includes means to cooperate with the continuous groove to positively control the reciprocal movement of the vane within the slot of the rotor.

Preferably a pin projects from the vane and engages within the groove to positively control the reciprocal movement of the vane during rotation of the rotor.

Preferably the vane includes:

a vane carriage adapted to reciprocate within the slot formed in the rotor, an outwardly extending groove the major axis of which is radial to the drive shaft formed in each side edge of the vane carriage and a groove formed in the tip of the vane carriage to extend between the grooves formed in the sides of the vane carriage

spacer members located in the side grooves of the vane carriage and a seal insert located within the groove in the tip of the vane carriage

a compression spring comprising two spaced apart parallel legs joined by a bridge portion, the legs of the spring being located in the side grooves of the vane carriage between the spacer members and the root of the groove and the bridge of the spring being located in the groove in the tip of the carriage between the seal insert and the root of the groove, the construction and arrangement being that the spring will exert outward compressive forces to maintain the spacer members and the seal insert in sealing contact with the bore of the stator.

Preferably the surface of the wall of the bore of the stator is shaped into a curve.

Preferably the shape of the curve is generated by an arc having a radial centre on a notional circle concentric with the drive shaft..

Preferably each vane includes a resilient sealing means shaped to complement the curve of the wall of the bore of the stator, means being provided to maintain a sealing surface of the vane in contact with the curved surface of the bore of the stator.

**Brief description of the drawings**

A preferred form of the invention will now be described with the aid of the accompanying drawings, wherein:

Figure 1 is general diagrammatic view of the exterior of an engine constructed according to the present invention.

Figure 2 is a side elevational diagrammatic view of the exterior of one preferred form of an engine constructed according to this invention.

Figures 3a, 3b, 3c and 3d are sectional views along the line A-A of Figure 2 of the interior of the induction/compression section illustrating the positions adopted by the rotor for the various phases during the rotation of the rotor.

Figures 4a, 4b, 4c and 4d are sectional views along the line B – B of Figure 2 of the interior of the combustion/exhaust section illustrating the positions adopted by the rotor during the various phases of the combustion/exhaust.

Figure 5 is a sectional view through a part of the stator and the rotor illustrating one method of effecting reciprocal movement of the vanes.

Figure 6 is a sectional view along the line VI - VI of Figure 2.

Figure 7 an exploded view of the component parts of one preferred form of a vane.

Figure 8 is a cross sectional view similar to that of Figure 5 illustrating a modification of the construction of the engine.

Figure 9 is a cross sectional view similar to that of Figure 6 but of the modification illustrated in Figure 8.

**Detailed description of the preferred embodiment.**

As illustrated in the drawings, the engine comprises an induction/compression section 1 and a combustion/exhaust section 2. Each section comprises a stator and the induction/compression section includes inlet port 3 and an exhaust transfer port 4. The

combustion/exhaust section 2 includes an inlet transfer port 5 and an exhaust port 6. The exhaust transfer port 4 of the section 1 is connected by piping 7 to the inlet transfer port 5 of the second section 2. Valve means 8 is positioned in the piping to allow compressed gases to be transferred from the section 1 to the section 2 at the required intervals and to prevent the back flow of gases from the section 2 into the section 1. One such valve means is illustrated in Figure 4. In this illustration the valve means 8 is located within the inlet port and can consist of a rotary valve 10 such as that illustrated. The valve 10 can be connected through suitable gearing such as that illustrated diagrammatically at 9 or by other known means to the drive shaft 15 so the timing of the opening and closing of the valve 10 will be positively controlled. Although in the illustration a rotary valve is depicted to time and effect the entry of combustible gases 12 from the section 1 to the section 2, it is to be understood that any other suitable valve mechanism and valve timing apparatus can be utilised for this purpose.

The bore of the stator is in the shape of two arcs of a circle with the axis of the radius forming the part of the arc 20 being offset from the axis of the radius forming the arc 21. The drive shaft 15 is journalled in bearings (not shown in the drawings) which are located in end plates 40 of the stator. The axial centre of the bearings and therefore of the drive shaft 15 equates to the axial centre of the portion forming the arc 21 of the bore. A rotor 25 is appropriately fixed to the drive shaft 15 so that rotation of the rotor will rotate the drive shaft 15. The periphery 26 of the rotor 25 is circular and as can be seen from the drawings, the periphery 26 will lie closely adjacent to the surface of the arc 21 but does not

contact the surface. Consequently as the rotor 25 rotates, the periphery 26 will maintain a constant distance from the surface of the arc 21.

The rotor 25 includes radial slots 30 and in the drawings two such slots 30 are illustrated. Each slot houses a vane 31 which can have radial reciprocating movement within the slot. The vane can be composed of a suitable material that will provide minimum friction between the side wall of the vane and the interior of the slot 30 and which will not be adversely affected by the combustible gases, the combustion process or the heat graduations imposed on it during an operating cycle. Each vane has a tip 32 composed of a material that will form an effective gas seal against the bore of the stator and provide a satisfactory service life as will be described in greater detail later.

Each vane is provided with a pin 35, the axis of which is substantially parallel to the axis of the shaft 15 and extends out the end face 33 of the rotor 25.

The stator is provided with end plates 40, each of which has a cavity to receive a cam plate 41 which has a continuous groove 42, the axis of which corresponds to the axis of the arc 20 of the bore of the stator. The groove 42 is of a width and depth that the end of the pin 35 can engage within the groove as a neat but sliding fit. Preferably but not essentially each end plate 40 of the stator includes the cam plate 41 and groove 42. As is also illustrated in Figure 5, the cam plate is preferably located in the end plate 40 by means of locating pins which register within locating holes 43 formed in the face of the end wall of the stator. The purpose of the locating pins is to allow the cam plate 41 to be manually

rotated so the timing of the movement of the vanes can be altered as required by rotating the cam plate in relation to the end plate 40. When in the desired location, the locating pins are fixed within the locating holes 43 to prevent movement of the cam plate 41 until further adjustment is required.

Figure 7 illustrates an alternative form of vane suitable for use with the rotor of the present invention. In the form illustrated a vane carriage 50 comprises a solid billet of essentially rectangular shape and is provided with pins 54 which project from the sides of the vane carriage and which correspond with and replace the pins 35 previously described in relation to Figures 3, 4 and 5. Each vane carriage is of a size that it can be engaged within a slot 30 in the rotor 25 as a neat but sliding fit. A groove 51 is formed in the sides 52 and end 53 of the vane carriage 50 and a tension spring 55 is located in the groove. The spring 55 includes arms 56 that are splayed as indicated. Spacer members 58 are provided which can fit within the grooves on the sides of the vane carriage with the base of the spacer members contacting the splayed portions of the spring 55. The distal end of each spacer member is preferably bevelled as illustrated so it can contact an equivalently bevelled end 60 of a seal insert 61. The seal insert 61 is preferably formed of a suitable sealing material so the sealing face 62 can seal against the interior of the bore of the stator and provide a gas seal during rotation of the rotor within the stator. As will be apparent to those skilled in the art, the spacer members 58 and the seal insert 61can be formed of a single piece of material or they can be formed of two or more laminate sections.

The seal insert 61 includes an anchor hole 63 so that after the seal insert 61, the spacer members and the spring 55 have been located within the groove 51, the assembled vane can be retained within the vane carriage 50 by passing an anchor pin 64 through the hole 65 formed in the vane carriage 50 and through the anchor hole 63. Preferably the diameter of the anchor hole 63 is greater than the diameter of the anchor pin to allow a limited movement of the seal insert 63 in relation to the remainder of the assembly of the van carriage 50. As is also illustrated in the Figure, the spring 55 is so shaped that it will exert a tension on the reverse face of the seal insert 61 to assist in maintaining contact between the seal and the wall of the bore of the stator. The movement of the seal is limited by the size of the anchor hole 63 in relation to the anchor pin 64.

In addition to the seal formed between the tip of the vane and the bore of the stator, suitable sealing means is also provided between the sides of the rotor and the end plates of the stator. Various forms of sealing devices as will be apparent to those skilled in this particular art can be utilised.

In the modification illustrated in Figures 8 and 9, each stator 80 is formed from two sections joined about the join line 81. The two sections can be maintained as a solid stator by suitable bolts or the like as will be known in the art. The assembled stator has a bore, the circumferential wall of which is shaped into two arcs 82 and 83 of a circle. The stator 84 is fixed to the drive shaft 85 journalled in the walls of the stator by suitable bearings (not shown in the drawings). In addition to having the arcs 82 and 83, the surface of the wall of the bore is curved as illustrated. The shape of the curve can be generated by a radius struck

from a notional circle concentric with the drive shaft 15. In a highly preferred form the curve is semi-circular but it will be understood other geometrical shapes can be utilised. The stator includes radially extending slots 86 and a vane carriage 87 is housed in each slot so it will have reciprocal sliding movement within the slot. The vane carriage has a curved sealing edge, the shape of which complements the shape of the curved surface of the bore of the stator. The outer surface of each vane carriage is shaped to receive a tensioned sealing member 88 which may consist of a plurality of separate members as illustrated although the nature of the sealing member can be varied as required for the particular circumstances. The outer surface of the sealing members will provide a gas seal against the surface of the bore of the stator. Preferably the vane carriage also include means to positively reciprocate the vanes within the slots. In a highly preferred form the vane carriages can be provided with pins such as those illustrated at 54 in Figure 6 which can engage within grooves 42 (see Figure 6) formed in the sides walls of the stator. The sealing means are formed of a resilient material which can continue to provide an outwardly extending tension to form a gas seal against the wall of the stator. In addition, the material forming the seals will be such that the seals are able to resist the effects of erosion, temperature and other forces that will be imposed on the seals in the environment.

A typical operation of the engine will now be described. Figure 3a illustrates the commencement of the induction phase. The rotor 25 has commenced rotation in the direction indicated by the arrow and this will create a partial vacuum and draw combustible gases 12 through the inlet port 3. As shown in Figure 3b the rotor has moved through approximately 90° and the space behind the vane 31 between the periphery of the rotor and

the wall of the portion 20 of the chamber is filled with combustible gases 12. As the rotor rotates, the vane 31 will pass the exhaust transfer port 4 and the space behind the vane will communicate with the exhaust transfer port 4. Continued rotation of the rotor will compress the combustible gases 12 and in the position indicated in Figure 3c, the combustible gases are being forced under pressure through the exhaust transfer port 4. As indicated at 70 in Figure 3a a one way valve can be inserted in the exhaust port to ensure no back flow of gases can pass through the port. Figure 3d illustrates the final phase of discharge of combustible gases through the exhaust transfer port 4. At this stage, a partial vacuum has been created behind the vane and a fresh charge of combustible gases will have been sucked into the chamber. It will this be understood that the configuration illustrated will enable two charges of combustible gas to be conducted, compressed and discharged for each revolution of the rotor.

Figures 4a illustrates the commencement of the filling of the space behind the vane which has just passed the inlet transfer port 5 which is connected to the exhaust port 4 from the induction/compression section 1. The rotary valve 10 has opened and gas that will be under pressure as a result of having being compressed by the section 1, will commence to fill the space behind the vane and between the periphery of the rotor and the wall of the bore. Further rotation of the rotor will result in the vane passing the spark plug 81 and at the position indicated at Figure 4b an electrical charge is conducted to the spark plug which will discharge and ignite the combustible mixture 12. The valve 10 will have rotated to the closed position indicated in this Figure and consequently the force of the expanding gases will be exerted behind the vane to move the rotor further in the direction of the arrow as

indicated in Figure 4c. Continued rotation of the rotor will mean that the vane will pass the exhaust port 6 and thus allow the combustible gas to exit through the exhaust port. As can be see in Figure 4d, while the combustible gases 72 are being discharged through the exhaust port 6, a fresh charge is filling the area behind the vane. Consequently in this configuration two combustion processes can be obtained for every revolution of the rotor.

Although in the highly preferred form, the rotary engine will be provided with two vanes in each section, it is to be understood that in certain circumstances it may be preferable to use only one vane or even a plurality of vanes in each section.

Having described the preferred embodiments of the invention, it will be apparent to those skilled in the art that modifications and amendments can be made to the construction of the engine and yet still come within the general concept of the invention. All such modifications and amendments as intended to be included in the scope of this invention which is defined in the appended claims.

CLAIMS

1. A rotary engine having separate induction/compression and combustion/exhaust units, each unit comprising a substantially identical stator having a bore into which an inlet port and an exhaust port communicate.

each stator housing a rotor which has a circular peripheral surface, the rotor being adapted to have rotatory movement within the bore by being connected to a common drive shaft journalled in bearings supported by the stators,

wherein the surface of the bore of the stator is in the shape of a first and a second arc having separate axes with at least the first arc being part of a circle and wherein the peripheral surface of each rotor is closely spaced from the wall of the bore formed by said first arc,

each rotor being provided with at least one vane which has a radial reciprocating movement guided within a slot formed in the rotor in a manner that as the rotor rotates, the vane will reciprocate in the rotor to maintain a sealing portion of the vane in sealing contact with the surface of the bore of the stator.

2. The rotary engine claimed in claim 1, wherein the reciprocating movement of the vane is controlled by control means to maintain the tip of the vane in sealing contact against surface of the second arc of the bore of the stator during rotatory movement of the rotor.

3. The rotary engine claimed in claim 2, wherein the control means comprises a continuous groove formed in at least one side wall of the stator with the shape of the groove complementing the shape of the said second arc and wherein the vane includes means to cooperate with the continuous groove to positively control the reciprocal movement of the vane within the slot of the rotor.

4. The rotary engine as claimed in claim 3, including a pin which projects from the vane and engages within the groove to positively control the reciprocal movement of the vane during rotation of the rotor.

5. The rotary engine as claimed in claim 1, wherein the vane includes:

a vane carriage adapted to reciprocate within the slot formed in the rotor, an outwardly extending groove the major axis of which is radial to the drive shaft formed in each side edge of the vane carriage and a groove formed in the tip of the vane carriage to extend between the grooves formed in the sides of the vane carriage

spacer members located in the side grooves of the vane carriage and a seal insert located within the groove in the tip of the vane carriage

a compression spring comprising two spaced apart parallel legs joined by a bridge portion, the legs of the spring being located in the side grooves of the vane carriage between the spacer members and the root of the groove and the bridge of the spring being located in the groove in the tip of the carriage between the seal insert and the root of the groove, the construction and arrangement being that the spring will exert outward compressive forces to

maintain the spacer members and the seal insert in sealing contact with the bore of the stator.

6. The rotary engine of claim 1, wherein the surface of the wall of the bore of the stator is shaped into a curve.

7. The rotary engine of claim 6, wherein the shape of the curve is generated by an arc having a radial centre on a notional circle concentric with the drive shaft..

8. The rotary engine of claim 6, wherein each vane includes a resilient sealing means shaped to complement the curve of the wall of the bore of the stator, means being provided to maintain a sealing surface of the vane in contact with the curved surface of the bore of the stator.

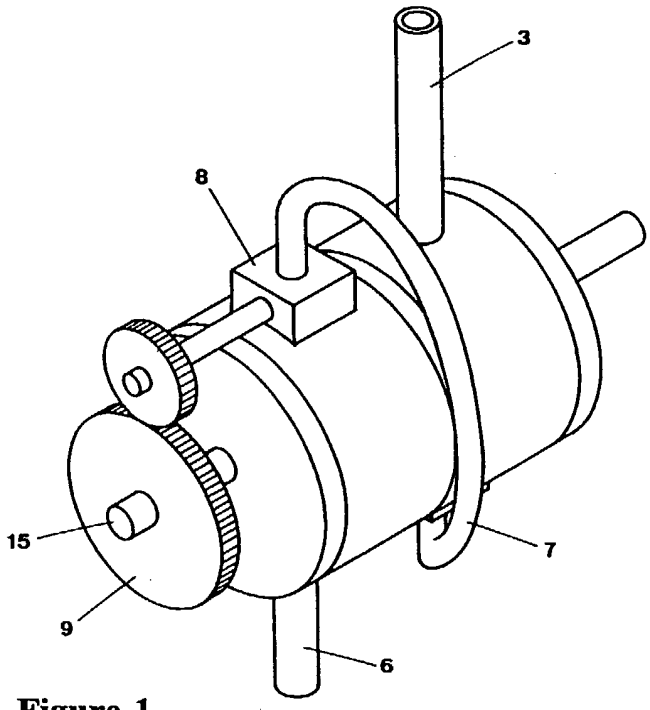



Figure 1

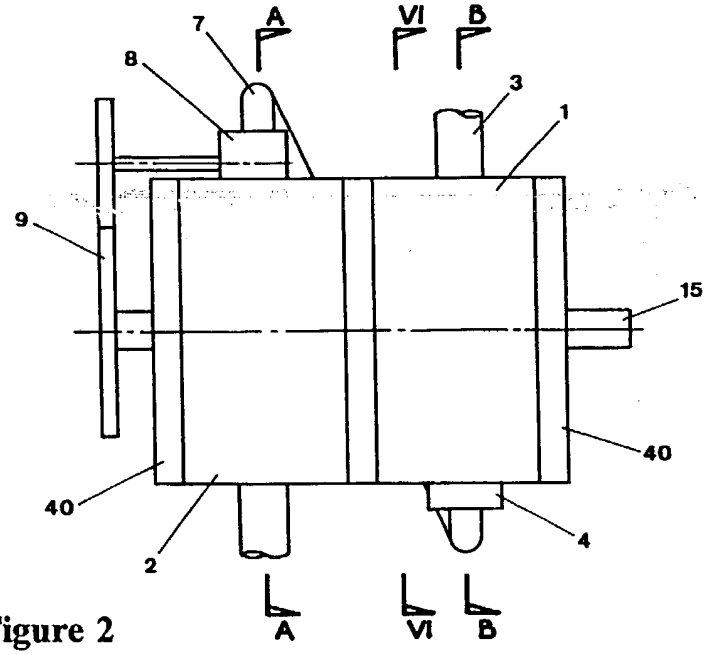



Figure 2

Figure 3a

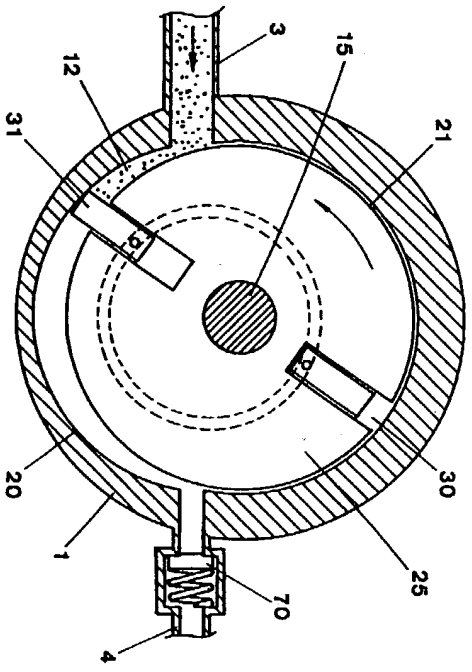



Figure 3b

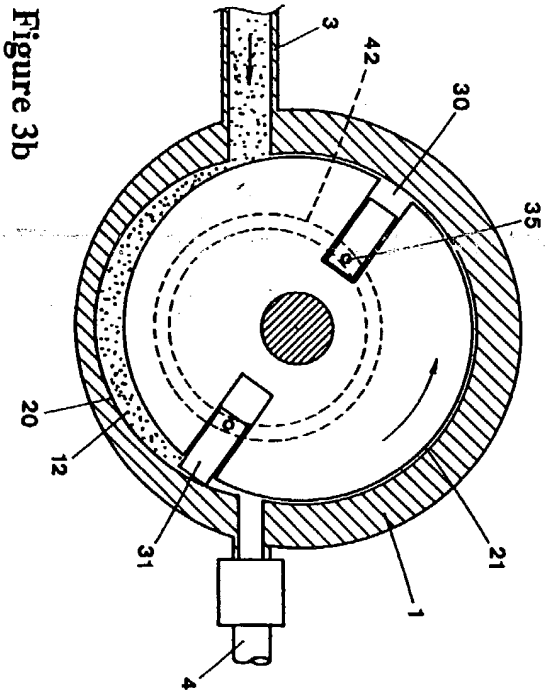



Figure 3c

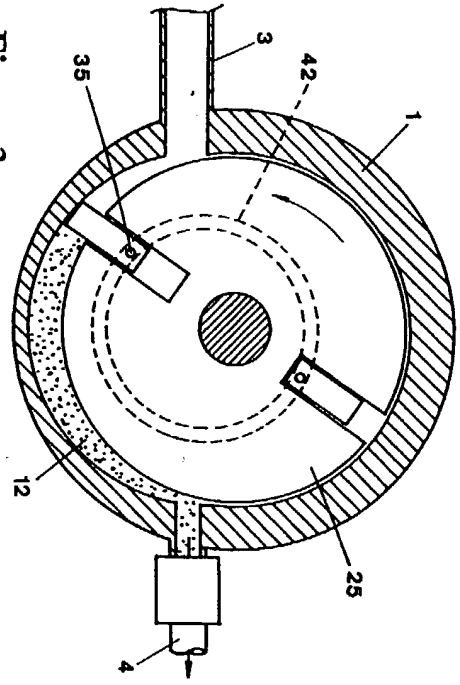
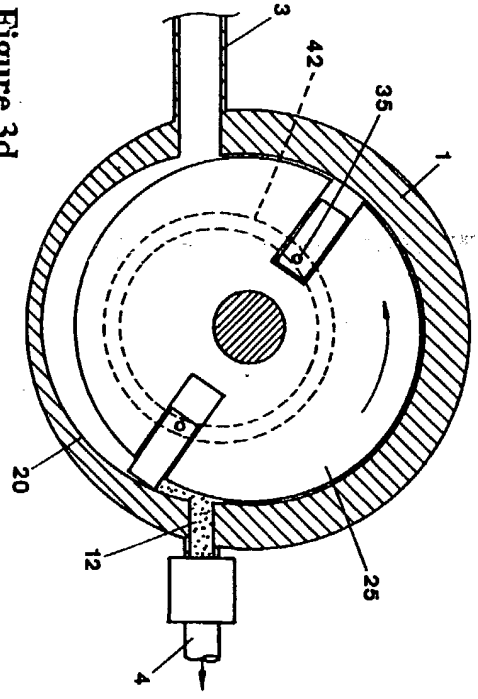



Figure 3d



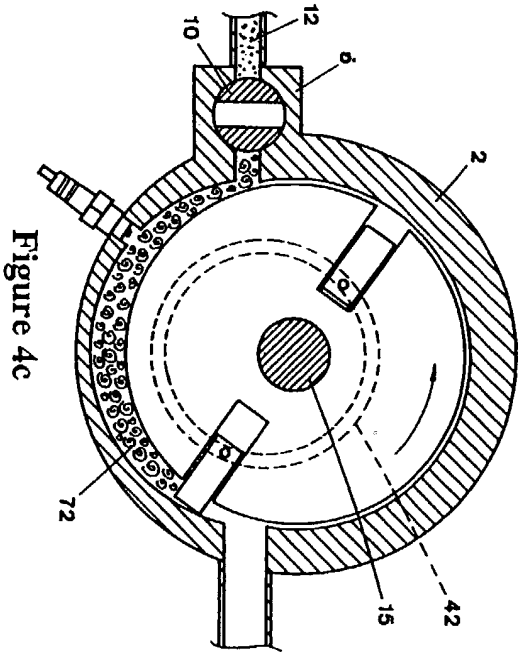



Figure 4c

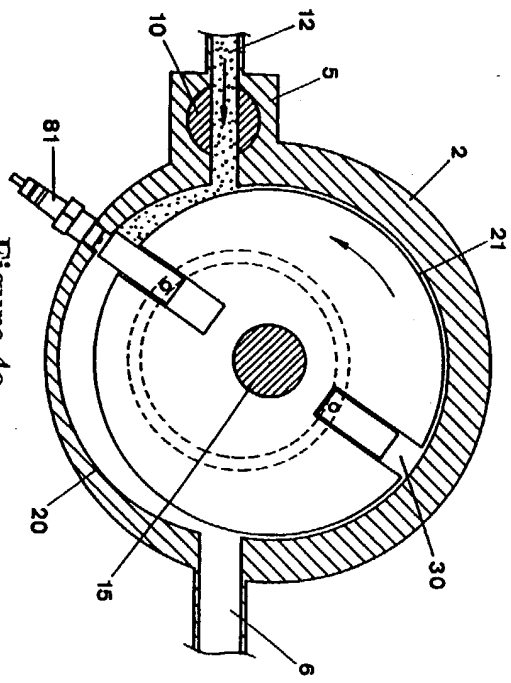



Figure 4a

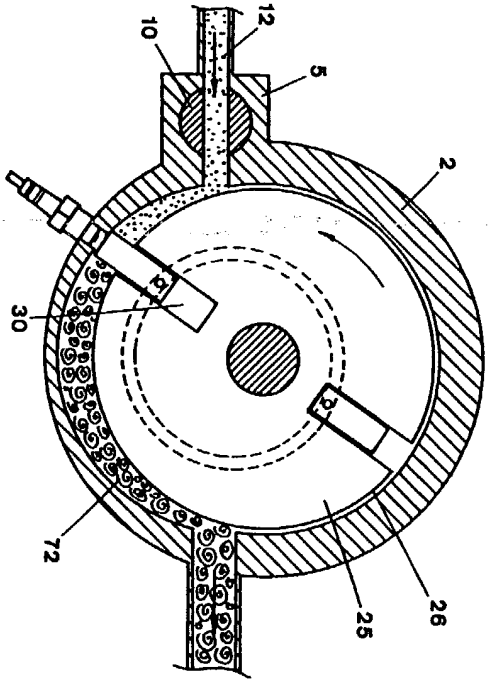



Figure 4d

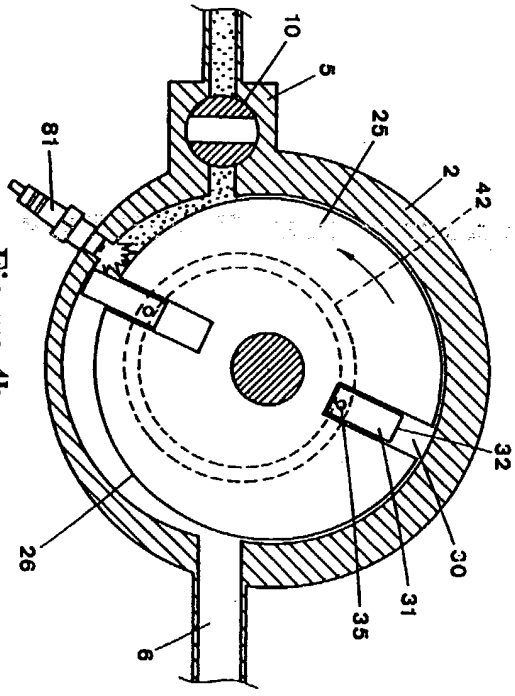



Figure 4b

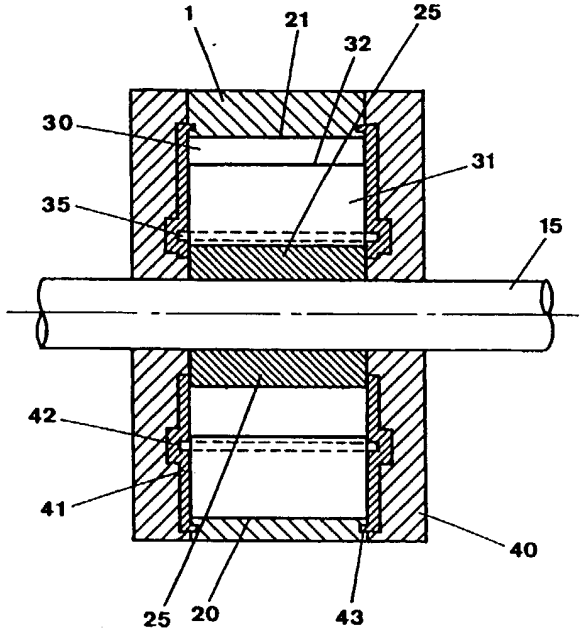



Figure 5

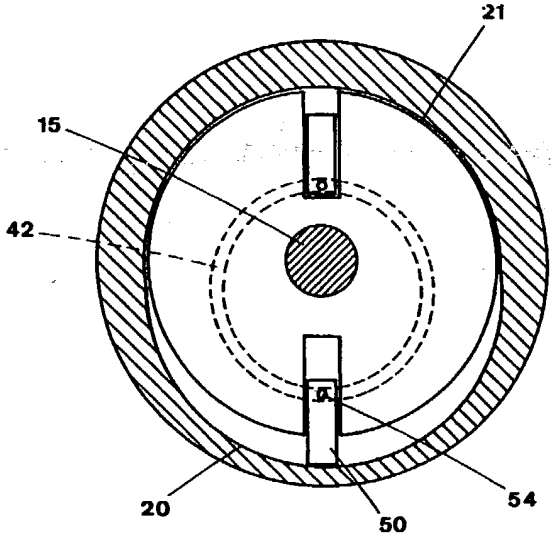



Figure 6

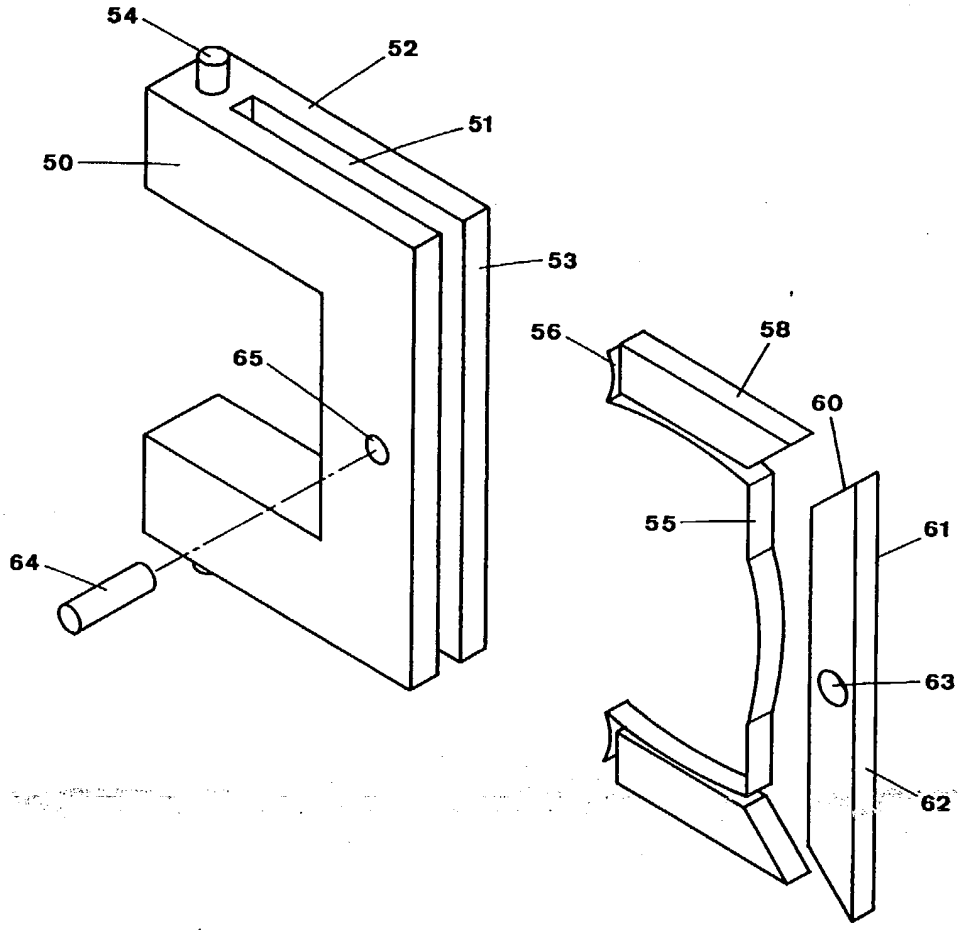



Figure 7

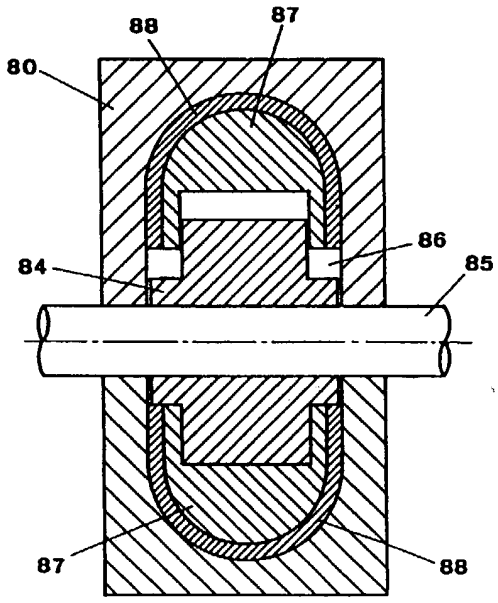



Figure 8

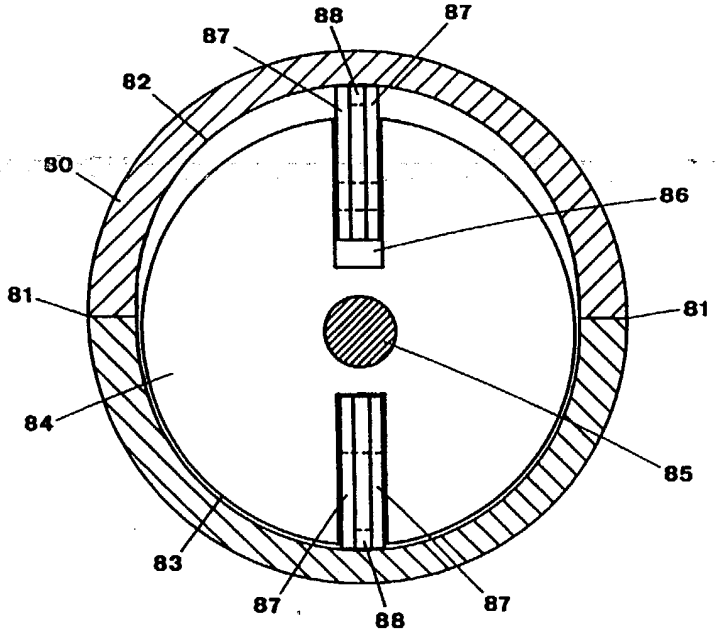



Figure 9

**INTERNATIONAL SEARCH REPORT**

International application No.
**PCT/NZ 98/00102**

**A. CLASSIFICATION OF SUBJECT MATTER**

Int Cl[6]: F01C 1/344, F02B 55/14, 55/16, 53/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC: F01C 1/344, 1/34, 21/08, F02B 55/14, 55/16, 53/00, 53/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU IPC: as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT, USPTO with keywords

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 4154208 A (KUNIEDA et al.) 15 May 1979<br>Figures 1, 2, column 2, line 50-column 3, line 20 | 1-4, 6-8 |
| Y | WO 97/48885 A1 (PELLEJA) 24 December 1997<br>Figures 2-8, 9 | 1-4, 6-8 |
| Y | US 5415141 A (McCANN) 16 May 1995<br>See the whole document | 1-4, 6-8 |

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 26 November 1998 | -3 DEC 1998 |
| Name and mailing address of the ISA/AU<br>AUSTRALIAN PATENT OFFICE<br>PO BOX 200<br>WODEN ACT 2606<br>AUSTRALIA<br>Facsimile No.: (02) 6285 3929 | Authorized officer<br>**ASANKA PERERA**<br>Telephone No.: (02) 6283 2373 |

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ 98/00102

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | AU 50192/90 A (McKENZIE) 10 January 1991<br>Figures 1, 2 | 1-4 |
| A | WO 97/37113 A1 (TANG) 09 October 1997<br>Abstract and figure | 1-4 |

## INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NZ 98/00102

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| Patent Document Cited in Search Report | | Patent Family Member | | | | | |
|---|---|---|---|---|---|---|---|
| US | 4154208 | DE | 2630128 | FR | 2317497 | GB | 1558261 |
| | | JP | 52008206 | JP | 52067409 | JP | 52076512 |
| | | JP | 52084305 | JP | 52084306 | | |
| WO | 97/48885 | CA | 2179468 | AU | 30207/97 | | |
| WO | 97/37113 | AU | 24687/97 | CN | 1160811 | | |

END OF ANNEX

DERWENT-ACC-NO: 1999-132353

DERWENT-WEEK: 200063



TITLE: Vane type rotary engine having separate induction-compression and combustion-exhaust units - surface of bore of stator is in shape of two arcs having separate axes with first arc being part of circle

INVENTOR: O'BRIEN, K J

PATENT-ASSIGNEE: O'BRIEN K J[OBRII] , O'BRIEN T J[OBRII]

PRIORITY-DATA: 1997NZ-0314072 (July 16, 1997)

PATENT-FAMILY:

| PUB-NO | PUB-DATE | LANGUAGE | PAGES | MAIN-IPC |
|---|---|---|---|---|
| WO 9904141 A1 | January 28, 1999 | E | 029 | F01C 001/344 |
| CN 1267354 A | September 20, 2000 | N/A | 000 | F01C 001/344 |
| AU 9882486 A | February 10, 1999 | N/A | 000 | F01C 001/344 |

EP 1009913 A1 June 21, 2000 E 000
F01C 001/344
BR 9810596 A September 12, 2000 N/A 000
F01C 001/344

DESIGNATED-STATES: AL AM AT AU AZ BA BB BG BR BY CA
CH CN CU CZ DE DK EE ES FI
GB GE GH GM HR HU ID IL IS JP KE KG KP KR KZ LC LK LR LS LT
LU LV MD MG MK MN
MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT
UA UG US UZ VN YU ZW AT
BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC
MW NL OA PT SD SE SZ
UG ZW AT BE DE DK ES FI FR GB GR IE IT NL PT SE

APPLICATION-DATA:

| PUB-NO | APPL-DESCRIPTOR | APPL-NO | APPL-DATE |
|---|---|---|---|
| WO 9904141A1 | N/A | 1998WO-NZ00102 | July 15, 1998 |
| CN 1267354A | N/A | 1998CN-0808182 | July 15, 1998 |
| AU 9882486A | N/A | 1998AU-0082486 | July 15, 1998 |
| AU 9882486A | Based on | WO 9904141 | N/A |
| EP 1009913A1 | N/A | 1998EP-0932656 | July 15, 1998 |
| EP 1009913A1 | N/A | 1998WO-NZ00102 | July 15, 1998 |

| | | | |
|---|---|---|---|
| EP 1009913A1 | Based on | WO 9904141 | N/A |
| BR 9810596A | N/A | 1998BR-0010596 | July 15, 1998 |
| BR 9810596A | N/A | 1998WO-NZ00102 | July 15, 1998 |
| BR 9810596A | Based on | WO 9904141 | N/A |

INT-CL (IPC): F01C001/344, F02B053/00 , F02B055/14 , F02B055/16

ABSTRACTED-PUB-NO: WO 9904141A

BASIC-ABSTRACT:

NOVELTY - The surface of the bore of the stator is in the shape of two arcs
having separate axes with the first arc being part of a circle and the
peripheral surface of each rotor being closely spaced from the wall of the bore
formed by the first arc. The reciprocating movement of the vane is controlled
to maintain the tip of the vane in sealing contact against surface of the
second arc of the bore of the stator.

USE - As a rotary internal combustion engine.

ADVANTAGE - Provides simplified construction.

DESCRIPTION OF DRAWING(S) - The drawings show sectional views of the interior
of the induction-compression section illustrating the positions adopted by the
rotor for the various phases during the rotation of the rotor.

CHOSEN-DRAWING: Dwg.3a-d/9

TITLE-TERMS: VANE TYPE ROTATING ENGINE SEPARATE INDUCTION COMPRESS COMBUST
EXHAUST UNIT SURFACE BORE STATOR SHAPE TWO ARC SEPARATE AXIS FIRST
ARC PART CIRCLE

DERWENT-CLASS: Q51 Q52

SECONDARY-ACC-NO:
Non-CPI Secondary Accession Numbers: N1999-096325